

CLAIMS

1. A seamless expandable oil country tubular goods comprising: on a mass percent basis, 0.010% to less than 0.10% of C, 0.05% to 1% of Si, 0.5% to 4% of Mn, 0.03% or less of P, 0.015% or less of S, 0.01% to 0.06% of Al, 0.007% or less of N, and 0.005% or less of O; at least one of Nb, Mo, and Cr which are contained in the range of 0.01% to 0.2% of Nb, 0.05% to 0.5% of Mo, and 0.05% to 1.5% of Cr, so that the following equations (1) and (2) are satisfied; and Fe and unavoidable impurities as the balance.

Note

$$Mn + 0.9 \times Cr + 2.6 \times Mo \geq 2.0 \quad (1)$$

$$4 \times C - 0.3 \times Si + Mn + 1.3 \times Cr + 1.5 \times Mo \leq 4.5 \quad (2)$$

In the above equations, the symbol of element represents the content (mass percent) of the element contained in steel.

2. The seamless expandable oil country tubular goods according to Claim 1, further comprising, instead of a part of Fe, at least one of 0.05% to 1% of Ni, 0.05% to 1% of Cu, 0.005% to 0.2% of V, 0.005% to 0.2% of Ti, 0.0005% to 0.0035% of B, and 0.001% to 0.005% of Ca.

3. The seamless expandable oil country tubular goods according to Claim 1 or 2, wherein, instead of the equations (1) and (2), the following equations (3) and (4) are satisfied.

Note

$$\text{Mn}+0.9\times\text{Cr}+2.6\times\text{Mo}+0.3\times\text{Ni}+0.3\times\text{Cu}\geq2.0 \quad (3)$$

$$4\times\text{C}-0.3\times\text{Si}+\text{Mn}+1.3\times\text{Cr}+1.5\times\text{Mo}+0.3\times\text{Ni}+0.6\times\text{Cu}\leq4.5 \quad (4)$$

In the above equations, the symbol of element represents the content (mass percent) of the element contained in steel.

4. The seamless expandable oil country tubular goods according to one of Claims 1 to 3, wherein the microstructure of a steel pipe contains ferrite at a volume fraction of 5% to 70% and the balance substantially composed of a low temperature-transforming phase.

5. A method for manufacturing a seamless expandable oil country tubular goods, comprising the steps of: heating a raw material for a steel pipe, the raw material containing, on a mass percent basis, 0.010% to less than 0.10% of C, 0.05% to 1% of Si, 0. 5% to 4% of Mn, 0.03% or less of P, 0.015% or less of S, 0.01% to 0.06% of Al, 0.007% or less of N, and 0.005% or less of O, at least one of 0.01% to 0.2% of Nb, 0.05% to 0.5% of Mo, and 0.05 to 1.5% of Cr, whenever necessary, at least one of 0.05% to 1% of Ni, 0.05% to 1% of Cu, 0.005% to 0.2% of V, 0.005% to 0.2% of Ti, 0.0005% to 0.0035% of B, and 0.001% to 0.005% of Ca, so that the following equations (3) and (4) are satisfied, and Fe and unavoidable impurities as the balance; forming a pipe by a seamless steel pipe-forming process which is performed at a rolling finish temperature of 800°C or more; and whenever necessary, performing normalizing treatment after the pipe forming is performed by the seamless steel pipe-forming process.

Note

$$\text{Mn}+0.9\times\text{Cr}+2.6\times\text{Mo}+0.3\times\text{Ni}+0.3\times\text{Cu}\geq2.0 \quad (3)$$

$$4\times\text{C}-0.3\times\text{Si}+\text{Mn}+1.3\times\text{Cr}+1.5\times\text{Mo}+0.3\times\text{Ni}+0.6\times\text{Cu}\leq4.5 \quad (4)$$

In the above equations, the symbol of element represents the content (mass percent) of the element contained in steel.

6. A method for manufacturing a seamless expandable oil country tubular goods comprising the steps of: after heating of the raw material for a steel pipe according to Claim 5 is performed, and pipe forming is performed by a seamless steel pipe-forming process, holding the pipe in the region of from point A₁ to point A₃ for five minuets or more as final heat treatment, and then performing air cooling.